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Mind-reading *versus* neuromarketing: how does a product make an impact on the consumer?

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These findings were presented in sessions on new research approaches to food marketing with Klaus Grunert and Howard Moskowitz at the 3rd Food Choice Conference at McMaster University (Booth & Freeman, 1995).

Abstract

Purpose – This research study illustrated the mapping of each consumer's mental processes in a market-relevant context. This paper shows how such maps deliver operational insights that cannot be gained by physical methods such as brain imaging.

Design/methodology/approach – A marketed conceptual attribute and a sensed material characteristic of a popular product were varied across presentations in a common use. The relative acceptability of each proposition was rated together with analytical descriptors. The mental interaction that determined each consumer's preferences was calculated from the individual's performance at discriminating each viewed sample from a personal norm. These personal cognitive characteristics were aggregated into maps of demand in the market for subpanels who bought for the senses or for the attribute.

Findings – Each of 18 hypothesised mental processes dominated acceptance in at least a few individuals among both sensory and conceptual purchasers. Consumers using their own descriptive vocabulary processed the factors in appeal of the product more centrally. The sensory and conceptual factors tested were most often processed separately but a minority of consumers treated them as identical. The personal ideal points used in the integration of information showed that consumers wished for extremes of the marketed concept that are technologically challenging or even impossible. None of this evidence could be obtained from brain imaging, casting in question its usefulness in marketing.

Research limitations/implications – Panel mapping of multiple discriminations from a personal norm fills three major gaps in consumer marketing research. First, preference scores are related to major influences on choices and their cognitive interactions in the mind. Second, the calculations are completed on the individual's data and the cognitive parameters of each consumer's behaviour are aggregated -- never the raw scores. Third, discrimination scaling puts marketed symbolic attributes and sensed material characteristics on the same footing, hence measuring their causal interactions for the first time.

Practical implications – Neuromarketing is an unworkable proposition because brain imaging does not distinguish qualitative differences in behavior. Preference tests are operationally effective when designed and analysed to relate behavioral scores to major influences from market concepts and sensory qualities in interaction. The particular interactions measured in the reported study relate to the major market for healthy eating.

Originality/value – This is the first study to measure mental interactions among determinants of preference, as well as including both a marketed concept and a sensed characteristic. Such an approach could be of great value to consumer marketing, both defensively and creatively.

Keywords neuromarketing, individual acceptance, personal norms, conceptual-sensory interaction, peripheral and central processing

INTRODUCTION

This paper illustrates how research into marketing can read the mind of each consumer while s/he makes choices in a particular situation of the purchase or use of a brand within a product range. The specific example here is the visually sensed and quantitatively labelled fat contents of samples of butter-free spread on bread. An innovative fundamental theory of how a mind works is applied to diagnose the cognitive-affective processes that drive each consumer's decisions.

Dissatisfaction in consumer research with existing structured models and the testing of discrete hypotheses has turned some to look for consumers' 'buttons' by physical methods, such as eye movements and even brain imaging (Fugate, 2007; Lee, Broderick and Chamberlain, 2007; see also Cohen, 2008, for brain imaging used to criticise marketing). Yet any differences in physical reaction observed between consumers or proposed products still have to be translated into behavior in the market. Research on consumer choice processes therefore must do better. This paper presents an innovative way forward in some of its key aspects.

The research base for advocacy of "neuromarketing" is extraordinarily thin. Distributions of activation in the brain are highly complex, statistically challenging, and hard to replicate. Brain imaging has been used to pursue highly abstract distinctions, such as between a brand and a person (Yoon *et al*., 2006), or for the sake of pointing to something physical when the facts are plain from regular behavioral research (McClure *et al*., 2004). Brain imaging breaks down as a guide to marketing strategy when the grouped neural data are reconsidered in the light of the behavior of individuals within each group. Such individual idiosyncrasy puts neuromarketing into the realm of science fiction.

The weaknesses of brain imaging relative to psychological analysis are illustrated by a pair of recent studies related to the present topic of the marketing of low fat foods. People suffering from type 2 diabetes (not needing injections of insulin) receive more intensive education in healthy eating than do many in the general population. The emphasis is on avoiding fatty foods, with little long-term concern about sugar (even in diabetes) or about portion sizes independently of fat contents. Brain imaging showed that the fat contents of unlabeled foods in color photographs produced the greatest activation in a region of frontal cortex important to the transformation of sensed characteristics into expected outcomes of action, with sugar trailing far behind and portion size having negligible effect on such neural activity (Chechlacz, Rotshtein, Klamer *et al*., 2009). A group with diabetes showed greater activation by fat than did the control group. Nevertheless it would be a mistake to 'neuromarket' low fat foods more intensively to the increasing segment of the market comprised of consumers having obesity-related diabetes and exposed to intensive education in lifestyle management of their disease. Each of the brain-imaged consumers was later asked to rate desire to eat each pictured food (Galea, Chechlacz, Booth *et al*., 2008). Individualised cognitive

analysis of these data showed that by far the most powerful influence seen in anybody was that of fat on the attractiveness of the sight of low fat foods. Nevertheless, a majority of those with diabetes had exactly the same distribution of fat preferences as the control group. Furthermore, fat content dominated the desire to eat a food in barely half of each group, with a minority dominated by sugar content and a few by portion size (Galea *et al*., 2008). Purely cognitive segmentation showed that type 2 diabetes was no better a market for low fat foods than the mass of consumers.

The solely behavioral data were sufficient to confirm that beliefs about fat can drive acceptance or avoidance of a food. Brain imaging merely showed the activation of regions already known to be involved in such incentive motivation. Furthermore those physical data told us nothing about the motivating roles of either visible signs of fat in a food or knowledge about the proportion of fat in the food (learned before the experiment by reading labels or other means), let alone how information from these two sources interacted during the decisions on use of each food item.

This paper reports results that begin to provide evidence on those issues by a purely psychological method. Its basic theory is unique in uniting the cognitive processing of sensory factors (such as viewed amount of food) and conceptual factors (such as labelled content of fat).

Recent work on conceptual-sensory interactions in general is reviewed first. Then the focus is turned to the concepts used in marketing low-fat foods and their interactions with sensed characteristics.

THEORETICAL FOUNDATIONS

Conceptual-Sensory Interactions in the Market

The likelihood of major interactions between nutrient labels and sensory preferences has long been emphasised (recently in this journal by Bates *et al*., 2011). Experimental interest in sensory-conceptual interactions has widened recently but the evidence remains non-specific cognitively. Wansink, van Ittersum and Painter (2005) reported indications that evaluative labels of restaurant dishes were assimilated to sensory expectations. Previously, Wansink *et al*. (2004) had characterised research generally on halo effects of labelling on sensory evaluations of food as giving mixed results. In part, that may be because of lack of attention to differences between individuals in how labelling interacts with sensory appeal.

Elder and Krishna (2010) added evidence that the slogans and other copy in advertisements for foods improved their sensory appeal, both in concepts and in evaluations. Names of foods affect neural responses to aroma (de Araujo *et al*., 2005). When the relation to healthy options is explicit, labelling as unhealthy increases the expected sensory appeal (Raghunathan, Naylor and Hoyer,

2006). Nevertheless, these more focused approaches still do not specify cognitive mechanisms, let alone variations in them among individuals.

The key further questions are how the conceptual factors interact with the sensory factors also being processed, visually at the point of purchase, and across the senses during use (Booth, 2013). The present paper reports results from one of the first pair of experiments to address such issues by measuring the cognitive interactions in each individual between a marketed health attribute and a salient sensed characteristic of a fast moving consumer good in a frequent use situation. The other experiment was on sweeteners in soft drinks (Freeman and Booth, 1993, 2010; Freeman *et al*., 1993). The experiment reported here used assessment of spreading fats to measure the mental processing of both the sensed material characteristic of the size of the portion and also the conceptualised market attribute of the portion's fat content (Booth and Freeman, 1999; Freeman, 1996). Both factors relate directly to efforts by food marketers and technologists to aid the lowering of the proportion of fat in the diet across the population, a major aspect of healthier eating.

This innovative approach is multithetic: multiple hypotheses are pitted against each other, rather than testing each hypothesis in turn against the null hypothesis. Furthermore, these hypotheses are systematic, covering the whole set of processes that occur in relevant variations of circumstances, rather than merely contrasting particular conditions. Crucially, the design and analysis are tested among the hypotheses on each consumer's performance of perception and action. That is, the data presented here were fully analysed in each individual before aggregation of their performance characteristics across the panel, rather than lumping the panel's data together before analysis.

Conceptual and Sensory Factors in Uses of Low-Fat Foods

The mental processes involved in deciding to buy or to eat foods low or high in fats have been investigated indirectly in several ways in recent years. Planning to choose lower-fat options increases the likelihood that they will be eaten (Armitage, 2004). The setting affects what features of a food are attended to – sensory characteristics more in a restaurant and health marketing aspects more in a hospital (Roefs, Quaedackers, Werrij *et al*., 2006). Belief that you yourself actually can eat less fat affects the intention to do so, far more than knowing the risks from a high-fat diet or expecting such action to improve your own health (Scholz, Nagy, Goehner *et al*., 2009).

Despite this increasing interest in consumers' thoughts and feelings about low-fat foods, we have yet to find a publication that has focused on the mental processes in a consumer faced with options that apparently vary in their contents of fat. Furthermore, even dietary interventions that profess to be "cognitive" seldom differ from those that do not (Fabricatore, 2007). Yet each of the choices among foods contributing to daily intake of fat depends on how the situation is being processed in the mind of each eater at the moment of deciding how much to eat of what item.

One well known strategy of healthier eating while using spreading fats is to place only a thin layer on the bread (Blair, Booth, Lewis & Wainwright, 1989). Indeed also, one way to indulge in a deliciously flavored butter is to spread it thickly. Another health-related strategy is to select options that are lower in fat. In the hope of supporting such habits, governmental regulation of the labelling of foods has encouraged the development of spreads that mimic butter or margarine (which are at least 80% fat) but contain sufficiently less fat to be allowed to carry the label "low fat" or "reduced fat." The dairy fat may also be partly or wholly replaced by vegetable fats that are high in polyunsaturates or monounsaturates. Indeed, some consumers in the present experiment characterised a spread labelled "5% fat" as high in polyunsaturates. Whether or not labelled low in fat or low in saturates, a tub of spread must declare its total content of fats in units of grams per 100 g, commonly referred to as percent fat. Hence the propositions tested in this experiment varied independently in amount of a spread on a standard piece of bread and a written label beside the sample giving a percentage of fat for that example of spread.

STUDY PLAN

The experiment was run at an exhibition in the style of a hall/mall preference test, with supplementary quantitative descriptive analysis of each of the two manipulated variables. A succession of single samples was assigned to each participant for visual evaluation only. The appeal of each sample was assessed as the likelihood of choosing to eat the sample of spread on bread on an appropriate occasion. All participants were familiar with eating spread on bread. Each first stated the main consideration when buying spread. These data were used to segment the panel into those who had their spread bought for them, those who chose their spread for sensory reasons and those who selected the sub-brand out of concern for health. Half the panellists in each segment started by generating their own words to conceptualise the varied levels of the material feature (amount of spread) and of the symbolic attribute (labelled percent fat). The other half were given consensus words derived from a pilot study of individually elicited descriptors. Each panellist rated test samples selected by the investigator to be within her or his range of tolerance in terms of the free choice or consensus vocabulary for each of the two features.

The standard in memory (the norm) on which both acceptance judgments and the two conceptual assessments were anchored was the personally most preferred version of the product. The participant placed the test sample in a position on a line specified by two anchor positions on the same judged parameter, as in fact happens mentally if not physically for every format of rating (Booth, 2009). In this experiment, the other anchor on each rating was at a precisely identifiable low level, either never choosing the sample or none of the named feature.

HYPOTHESES

The hypotheses about each consumer's cognitive processing of information were of two types, first about three elemental sorts of process and then about two ways in which each element interacted with another element. For the two sources of information, that generated eighteen hypotheses (3 x 3 combinations, with two possible interactions of each of that nine).

The three sorts of cognitive process can be viewed as implementations of the distinction by Petty and Cacioppo (1986) between peripheral and central processing of attitudes and decisions. More peripheral processes are driven either by the stimuli or by the concepts behind the analytically descriptive words. More central processing of acceptance ratings involves relating concepts to stimuli. Such indirect processes are deeper in the mind because they are not connected one-to-one with a single observable.

These three elements of mentation also provide a contrast between explicit and implicit attitudes which is both simpler to measure and more specific in content than the results of Stroop-type tests (Implicit Attitude Test: Greenwald, McGhee and Schwartz, 1998). Both the influence of a response-concept and the more central response-concept modulation of a stimulus are explicit in their use of a concept, whereas the direct influence of a stimulus on acceptance may be implicit, involving no concept.

Finally, the default interaction between any two processes is that they are distinct influences on the integrative acceptance response – that is, the processes operate orthogonally. However, another hypothesis is that the two processes are treated as the same, or at least have something in common – that is, the processes summate in their influence on acceptance.

Such specificity of cognitive modelling opens up the possibility of testing the first formal hypothesis in those consumers whose choices were influenced by both the sensory factor and the conceptual factor.

> *H1*. Each individual consumer's choices will be dominated by one of the 18 sensory-conceptual interactions.

A subsidiary hypothesis concerned descriptive analysis of the sensory and conceptual factors. It is simpler to group individual data if descriptors are imposed by the investigators or, better, a previously extracted consensus of consumer-provided vocabulary is provided. However, vocabulary chosen by the individual should in principle be more sensitive than investigator-imposed terminology (Williams and Langron, 1984). In the present context, sensitivity could be expressed as better discrimination between levels of a sensory or conceptual feature. Finer differential acuity of a response for a stimulus is the same as stronger influence of that stimulus on that response. Hence free-choice vocabulary might dispose assessors to use the peripheral routes to acceptance, namely conceptualisation of the stimulus features or directly from sight of the features.

H2. Individually chosen terms for the conceptual attribute and the sensed characteristic will produce greater peripheral drive by those terms than provision of consensus vocabulary, i.e. the descriptive concepts will be used more often when individuals have produced their own terms.

Finally, it would be expected that habitual purchasing strategy affects mental processing at the point of choice. The sensory factor or its descriptive concept could be more dominant among those who selected their usual spread for 'taste' reasons. The conceptual factor or its descriptor might be used more often in those who usually bought the spread that they thought did most for their health.

H3. Cognitive processing is focused on the factor or concept consistent with declared purchasing strategy, for taste or for health, i.e. those who buy spread for health reasons will be influenced more by the concept of fat contents, whereas the thickness of the spread will be a greater influence on those who buy for "taste".

METHODOLOGY

Study Design

The experiment had two independent variables, each at levels selected from a fixed set to be tolerable to the individual participant.

Participants

A total of 300 young people took part, 232 female and 68 male. Almost all were 16 or 17 years of age, with 14 (5%) aged 20 years or over. They were guests of the University of Birmingham's Psychology Department on visiting days provided for those at high school who were interested in studying for a bachelor's degree, accompanied by their teachers.

Materials

Freshly bought, medium-sliced loaves of soft-grain bread were used without their crust. Each slice was cut into triangular quarters, each of which was covered evenly with a weighed amount of reduced-fat spread (40% fat). The weights were 2.0, 3.5, 6.0, 10.4 or 18.0 grams (ratios of a little over 1.7). Slices with each amount were placed on three small plates in a column, with each row labelled "5% FAT," "40% FAT" or "80% FAT"; these were the three levels of fat most commonly available at the time.

The array of samples was covered by a closed box for at least an hour before display began. The temperature of the room ranged from 15^{o}C to 20^{o}C on a maximum/minimum thermometer. The samples were kept out of sunlight and replenished frequently to avoid them looking dried out or visibly changing in other ways.

Conceptual Vocabulary

In a pilot study (not described here), ten out of eleven graduate students of psychology provided the words "fat" (7) or "fat content" (3) to describe the variation in the labels and "thickness" (6) or "amount," volume" or "quantity" (once each) for the variation in the spread; the other words were specific attributes (polyunsaturates; fattiness, oiliness, creaminess, wetness). Therefore, in the study itself the terms "fat content" and "thickness" were provided to panellists who were not prompted to use their own words. It should be noted that this consensus vocabulary was defined by the variation to be investigated, not by standards of other sorts. The other half of the panellists were allowed a free choice of terms for the visible variations. For these panelists, the variation among the labels was most often described as "fat content" (62%), "percent[age] fat" (14%) or "fat" (18%). The words elicited for amount of spread were predominantly "thickness" (76%), with small minorities giving "amount" (18%) or "quantity" and other words (6%).

We call these words conceptual terms rather than descriptors because the vocabulary by itself and any method of elicitation lacks evidence on the success or not of a person using the term at describing what the investigator assumes it describes, whether the term is self-chosen or provided. The scientific evidence for successful descriptive analysis is a high differential acuityfor the sensed characteristic achieved by an individual's quantitative use of the term in a session or, in order to generalise, by all panelists in all types of session.

Six of the 150 volunteers who used their own vocabulary did not complete the assessments. In order to have equal group sizes in a mixed-model 4-way ANOVA, data from the first six assessors in the 150 given the consensus terms were omitted from all analyses, leaving 144 individuals in each subpanel.

Layouts for Ratings

On presentation of a sample, the assessors first marked a point of their own choice on a vertical line with "I'd ALWAYS choose a piece of bread with spread like this" at the top and "I'd NEVER choose ..." at the bottom. Then they chose and marked a position on a horizontal line with a hatch mark in the middle and "fat content [or own vocabulary] just right for me" written above it, "no fat in spread at all" written at the left-hand end of the line and the phrase "too much" and a rightward pointing arrow placed below the right-hand half of the line, with no hatch mark. Finally each assessor marked a point on a line with mid-anchor "thickness [or own word] just right for me," "no spread" at the left hand end and "too much" with an arrow to the right.

It should be noted that the categories always label anchor points from which responses can be more or less distant. Anchor words or phrases should not be used as ranges (e.g., "just about right")

because the responses then fail to specify where the stimulus is judged to be between the widely separated borders of that range (Booth & Conner, 2009).

Minimisation of Biases on Quantitative Judgment

Presentation of stimuli without regard to the positioning of responses relative to the anchors is likely to distort the observed data from the straight-line psychophysical function by, for example, ceiling or floor (end) effects, centring bias at the start and range-frequency bias throughout (Booth *et al*., 1983; Conner *et al*., 1986, 1988a,b). It is therefore important not to present any sample that is likely to give a response close to or beyond "never choose." Such an intolerable sample can be identified with increasing accuracy by extrapolation of each emerging function from the second sample onwards.

The bias from the tendency to start at the middle of a response format can be minimised by selecting the first sample to be the experimenter's best guess at the level to which the assessor would give a middling rating. In this experiment, that was an amount of spread near the middle of the range on display and the % fat that was closest to that of the assessor's usual spread as stated before the start of the experiment.

Range bias was minimised by selecting the second sample to be somewhat beyond (or at least closer to) the individual's most preferred levels of fat content and amount of spread. Subsequent samples were selected to give equal numbers that were too high and too low in either content or amount. Generally six samples of spread on bread were tested on each assessor, occasionally five or seven. The number of samples is not critical for regression, unlike ANOVA.

Measurement of Conceptual and Sensory Discrimination by Preference

The individual's discriminations of disparities (ratios or differences) in amount and fat content (respectively) of spread and the cognitive interactions among these discriminative processes by acceptance and by rated concepts of amount and content were estimated from the raw data by a program in QuickBasic (appended to Freeman, 1996).

First, for each of these six overt functions in the session for each assessor, the best fitting least-squares linear regression equation was calculated, entering either logarithms of amounts or untransformed percentages of fat. The norm points were calculated by interpolation, e.g. for acceptance, to "always choose" to give the personal ideal point (IP) for the visible labelled fat content or amount of spread. The half-discriminated disparities (HDDs) were determined by entering the slope of the regression line and the mean squared error about the line into the traditional formula for the JND (Booth & Freeman, 1993; Conner *et al*., 1988a,b; Torgerson, 1958).

In each individual, the amount or fat content of each assessed sample was rescaled in HDDs

from IP and those values linearly regressed onto the acceptance ratings. In this paper, that calculation is called a direct (DIR) model of acceptance, because the rating on always/never choose is under immediate cognitive control of the viewed amount of spread or labelled % fat. When the ratings of the concept term for amount or content were scaled in HDDs from IP for regression to acceptance, this is called a conceptual model (CON). The final type of model constructed by this program uses a descriptive function in which a concept's HDDs from its IP for amount or content have been calculated for each food sample assessed and then linear regressions calculated from those norm-zeroed discrimination distances to the ratings of acceptance. Each such model represents indirect (IND) control of acceptance by the individual's centrally processed relationship between that stimulus feature and that response concept. A strong relationship is that person's objective success at using of the response term to describe the presented stimulus. To determine whether or not that achievement of a description is mediated by a sensation or a conscious percept, or indeed by a hedonic mental process, more elaborate calculations are required than those carried out by this program.

Pairs of the above elemental models were combined by the program either by adding the two HDDs from IP (a one-dimensional interaction, 1D) or by taking the square root of the sum of the squares of the values for HDDs from IP (two orthogonal dimensions, 2D), in accord with Pythagoras's Theorem. It should be noted that 1D models are in Euclidean space, just like the 2D models, not on a city-block metric as stated by Booth and Conner (1991); this approach is psychophysical (relating responses to stimuli), not psychometric (modelling responses without incorporating data on stimuli; Booth, 1995).

The program compared the variances in an individual's acceptance rating that are accounted for by each interactive model and used the most successful model as the best available estimate of any consistency in the individual's discriminative performance during the session. The input value that the individual used as the norm (e.g., ideal, market or standard) can also be estimated from the same input/output function regressed through the raw data as was used to estimate discriminative performance. This is because the ratings were anchored on the person's concept of a norm for the stimuli assessed in the session.

Hence a norm range can be specified for each assessor, as one half-discriminated disparity on either side of the norm point (NP). Counts of the panellist's norm ranges for a feature (each person's NP ± one HDD) provide a response profile for the panel (e.g., Booth, Mobini, Earl and Wainwright, 2003). The individuals' norm ranges for two influences on acceptance can be aggregated across any subsample of the panel chosen to give a response surface for a segment of the market or a socioeconomic, cultural or biological characteristic of interest. The segmentation of norm-range surfaces presented in this paper is by the individual's professed reason for purchasing

the food product type under investigation.

The 1D band or 2D ellipse of combined HDDs around the two-coordinates IP for each individual's best model was used to construct a contour map of counts of such ideal areas across the (sub)panel.

Statistical Analyses

Inferential ANOVAs were carried out in SPSS. Frequencies of categories were compared between groups or conditions in 2 x 2 contingency tables by Fisher's exact probability test up to N = 100 and χ^2 above that, using two-tailed p values.

RESULTS

Purchase Habit Panels

Participants were asked before the experiment began why they used their usual spread. One-quarter of the sample expressed some interest first in the contents or sourcing of the fat. A third gave a sensory reason first, such as liking the "taste." Nearly all the others used spread that was bought for them. These data were used to divide the sample into three sub-panels for separate testing of the hypotheses.

Individuality of Cognitive Processing

A majority of the participants (71%) integrated information from the sensory characteristic and conceptual attribute, and/or their descriptors. The appeal of the samples of spread on bread in the others was driven by only the amount of spread or the labelled percent of fat. The data from that minority are not considered further here.

Each of the nine hypothesised mental interactions between amount of spread and percent fat label was seen in at least a few of the integrative participants (Figures 3 and 4, combining all six subpanels). In the great majority of cases, the two features were processed separately up to the point of the deciding the rating of acceptance of each sample rating. That is, the integrative process was two-dimensional (2D; filled bars in Figures 1 and 2). Nevertheless, each of the nine theoretically possible unidimensional (1D) processes was used by at least three participants (open bars in Figures 1 and 2).

Figures 1 and 2 about here

That is, the expected diversity of cognitive processing was substantiated (*H1*). The question therefore is whether some types of interaction were more prevalent with one purchasing strategy than with another. Any such difference would also confirm that the instantiation of the 18 cognitive

processes was not random among consumers.

Free Choice *vs.* Consensus Vocabulary

It seems from an overview of Figures 1 and 2 that those who used consensus descriptors (Figure 1) were somewhat more constrained in their options among the processes of integration than those who were free to choose their descriptive terms (Figure 2). This impression is substantiated by some specific contrasts.

Participants who chose their own words to conceptualise the labelled percent of fat and the thickness of the spread more often used central than peripheral processes, among those who treated percent fat as different from amount of spread (2D integration). More of them processed fat % content descriptively (coded IND for indirectly in Figure 2) more often than directly (DIR) from sight of the label, i.e. on a peripheral route, $\chi^2(1) = 5.01$, $p < 0.03$. More of these participants also processed fat content by use of their own concept than without it. That is, either use of the concept alone (CON) or descriptively of the stimulus feature (IND) was more prevalent than direct stimulation of acceptance by the feature itself (DIR), $\chi^2(1) = 5.23$, $p < 0.025$. Thus, there was partial support for *H2*.

Among the participants who used their own vocabulary, those who bought their own spread showed clear differences between free-choice and consensus descriptors (Figures 1 and 2, lower two panels taken together) that were consistent with *H3*. Consensus vocabulary induced use of the sight of the fat% label (DIR) more frequently than acceptance was decided by an indirect process (IND) of description, Fisher exact $p < 0.001$. Most of this effect came from 2D processing involvement with the sight of the amount on the bread (DIR) among those who gave sensory reasons for buying their usual spread (middle panels) and 1D processing with the concept of amount among those expressing concern about fat (bottom panels of Figures 1 and 2). The spread itself could have been regarded as the sole source of sensory effects, separate from consideration of fat%. On the other hand, the amount of spread and its percentage content of fat have to be implicitly multiplied together to estimate the amount of fat in each sample, in order for that health parameter to drive the integrative response of acceptance.

Other differences between personally chosen and consensus vocabulary were evident in the participants who were concerned about fats in foods when they made their usual purchase of spread. There were no cases of the descriptive (IND) 1D process of fat % in those who were given consensus vocabulary (Figure 1, middle and bottom panels). Yet this integrative mechanism was relatively prevalent among those using their own words, $p < 0.02$ (Figure 2, bottom panel). These counts were similar to those using 2D processes to involve fat % in the decision to accept a sample of spread on bread. That is, the labelled fat % only seemed the same information as the thickness of

the spread when assessors used their own terms for both features of the samples. Again, a process akin to calculation of the amount of fat on the piece of bread could have determined acceptance in these participants, having been made easier by their own verbal conceptualisation of those two different types of information.

Among the assessors who stated that their usual spread was bought for them (top panel in each of Figures 1 and 2), there were no clear differences in prevalence of decision processes between those who were provided with consensus terms (Figure 1) and those who chose their own words to conceptualise amount and fat content of the spread (Figure 2). The only hint of a distinction between imposed and elicited terms in this segment was the possibility that treating labelled % fat and amount of spread as different (2D processing) was more often entirely conceptual (CON-2D-CON) when using one's own words (Figure 2), whereas conceptualised content was more often combined with direct stimulation by sight of amount (CON-2D-DIR) when words were provided (Figure1), Fisher exact $p = 0.17$.

Liking for the 'Taste' *vs.* Concern about the Fat

When assessors used their own wordings for amount of spread and percentage of fat, there were signs of differentiation in the mental processes of decision making between those who bought their usual spread for reasons of "taste" and those who had concerns about the fats in spreads (Figure 4, lower two panels), in line with hypothesis *H3*. Those who had their spread bought for them might be expected to include both of these extremes and therefore the distribution of cognitive models was relatively even (Figure2, top panel).

Those who chose their usual spread for taste were driven more often than those concerned about fats by visible amount of spread as a separate process from the sight of fat % (IND-2D-DIR, middle panel, Figure 2). The fats-concerned (bottom panel, Figure 2), on the other hand, were more often driven by their own word for amount (CON, back row of columns), particularly in combination with their word for fat % (CON) as separate semantic entities (2D models), or combining that word for amount (CON) with the description of fat % (IND) using their own words as a single process (1D models).

Aggregated Sensory and Conceptual Ideal Points

The calculation of each participant's mental mechanism of acceptance also yields the individual's most preferred level for percent fat and amount of spread in the circumstances tested. These ideal points can be aggregated into a frequency polygon (response surface) that can be most readily interpreted quantitatively from a contour plot (Figures 3 and 4). Two-dimensional processing contributes an ellipse to the contour map because the ideal points for each single feature

are distributed normally (Conner *et al*., 1988a,b). For 1D models, on the other hand, the ideal points form a diagonal line of frequency bins.

Most of these integrative assessors were optimising their choices on the minimum of fat consistent with having a little bit of spread on the otherwise bare slice of bread. Peak popularity ranged around the lowest percentage of fat presented on the labels (5%). At the low extreme, many of the personally discriminated ideal points were physically impossible negative percentages.

The assessors asked to use consensus descriptors gave a single broad ridge of greatest popularity (> 25%) from 1 g to 20 g and 100% to -100%, with only a small fork at 2-3 g and less than -100% of fat (Figure 3, upper panel). Allowing each individual to provide the vocabulary to conceptualise fat % and amount of spread on bread created more differentiation in the observed ideal ranges (Figure 3, lower panel). The main ridge may have been narrower (discriminating between fat percentages more finely) but longer (greater tolerance to greater and smaller thicknesses of spread). A strong ridge branched off to lower fat percentages, indeed negative values, broadening in range for ideals of smaller amounts of spread with negative fat content.

Figure 3 about here

Segmentation by professed reasons for buying the usual spread provided some elucidation of this pattern of ideal points among those who rated the samples in their own words. Those whose spread was bought for them (Figure 4, top panel) might be expected to have shown the most complex pattern because they included both those with sensory motivation and those with concerns about fats, each possibly other motives in addition. Two quite widely separated peaks of popularity emerged, one for thick spread and one for thin, each coming close to a presented extreme. A clear diagonal ridge of negative contents of fat also appeared but was confined to intermediate thicknesses of spread. Perhaps those concerned about the fat in their spread did not bother to calculate how much fat was in a sample when the spread was too thin to matter or so thick as to be past caring about exact fat intake.

Figure 4 about here

In more detail, most of the consumers in this heterogeneous segment were arrayed on the diagonal from high fat to negative fat on both label and amount. However, a small proportion liked 3-10 g of spread on a quarter-slice but with zero or less fat in it (Figure 4, top panel, fork below the main diagonal).

Specifically, a fifth of this segment preferred fat contents in the ranges between the two higher labels, 40% and 80%, and the larger three amounts, 6 g, 10.4 g and 18 g of spread. These young people might be said to ‘like butter on their bread.’

Another fifth showed a preference for zero fat in their spread or for much less than zero – that is, a spread that somehow removed fat from elsewhere in their diet! These assessors self-consistently

also preferred less fat on their bread than the next to smallest amount displayed (3.5 g per quarter-slice) down to about 1.5 g, less than the smallest amount shown (2 g).

The most complex response surface seen among these participants using their own words came from those who bought their spread for sensory reasons (Figure 4, middle panel). The most popular thickness of spread among these participants ranged to greater thickness than those concerned about fat (lower panel, Figure 4) and did not go down to as thinly spread. That pattern is consistent with enjoying the spread, with less regard for how much fat was in it. Nevertheless, among the participants who mentioned "taste" first as a purchasing strategy, a considerable proportion clearly also had concerns about the percept content of fat. The highest peak was on the ridge down below zero fat. There were two other peaks at extremely negative fat content levels.

The subpanel with concern about fats showed least differentiation over the response surface, despite the diversity of words that they used to describe the labelled percentage of fat. Perhaps the most interesting aspect was the sign of a cut-off at moderate amounts of spread. Presumably those who were concerned about the amount of fat in their diet wanted no more than a minimum thickness of spread, however low in fat it was.

DISCUSSION

Interpretation of the Present Findings

The results reported here show that consumers use a great variety of qualitatively distinct mental processes to integrate conceptual and sensory features into the disposition to choose a particular brand in a given context. A systematic effort has been made recently to relate sensory and conceptual approaches in food consumer research (Moskowitz, Beckley and Resurreccion, 2006). However, the proposed analyses do not identify the mechanisms by which each consumer integrates the two sorts of influence into objective perceptions and behavioral preferences.

Interactions among conceptual factors in consumers' choices can be tackled by conjoint analysis of part worths (e.g. Foley *et al*., 2009; Gofman, 2006; Oh, 2003; Sparke and Menrad, 2011), including the degradation of quality by responding to demand for utility (Petrick, 2005). However these approaches do not provide evidence on the cognitive mechanisms by which the part-worth functions interact within each assessor's mind to produce action in life. Multiple discrimination scaling fills that gap. Furthermore, conjoint measurement generally cannot include sensed characteristics, as distinct from labels of expected sensory quality. Hence the best attempts to marry conjoint to sensory methods still fail (De Pelsmaeker, Dewettinck and Gellynck, 2013; Moskowitz *et al*., 2006). Conversely, unbranded sensory testing has no access to mechanisms by which sensed

material characteristics interact in perception and preference.

The psychological theory necessary to measuring influences on individual consumers was formulated by Booth and Freeman (1993) on the basis of work on single sensed characteristics of foods tested in their usual context of conceptual attributions and other sensory factors (Booth *et al*., 1983). All influences on choice (or any other graded response) are put onto the same metric. This is not a statistical size of effect such as part-worth or utility, or fit to the data of a structural model. It is a universal measure of strength of influence, namely how good the response is at distinguishing between levels of the influence in the data collected from the individual in a session simulating a familiar context of use of a category of product. Distances from a standard constructed by the consumer for the tested situation are then used to test performance against all the theoretically feasible mental interactions that are accessible in the design.

The study presented here shows how, as well as disposition to choose, hypothetical relevant concepts can be evaluated from ratings using either the investigators' consensus terms, validated on the market, or on the individual's vocabulary. What is modeled is not what the investigator assumes that such a concept describes or calls attention to but what the assessor actually does with it.

The hypotheses are realistic to the system of processes in a mind, rather than mere contrasts between conditions in grouped data. The design tested multiple hypotheses on each individual's performance on a marketed health attribute and a salient sensed characteristic of a fast moving consumer good in a frequent use situation.

Implications for Research

The personal cognitive approach enables the determination of what consumers want to the finest grain that is needed by marketing and its technological support. If some hypotheses about the design of spreads and their packaging, pricing and advertising are not addressed by the design presented here, then other sensory or conceptual features need be varied and/or other analytical responses introduced.

The two segments who bought their own spread differed in a greater diversity of popularity peaks among those who bought for taste. Further investigation would be needed to begin to understand such ‘clusters.’ Additional questioning might have opened up possibilities of difference between individuals in what was liked about the usual spread. However, firm data would have required checking hypotheses based on interviews or focus groups by normed discrimination experiments that manipulated or selected unconfounded variations in hypothesised liked features. Both the relative saliences of features in acceptance and the ideal point for each feature need to be determined individually with a view to aggregation across appropriately representative panels.

MANAGERIAL GUIDANCE

Distributions of Ideal Points

There was a large area of overlap in popularity peaks between those who first mentioned liking the "taste" of the spread when asked why they choose their usual brand and those who mentioned first something about its fat content. Rather subtle aspects of the findings should not be neglected in product development policy if they stood up in panels that are representative of the whole markets. There were two clear differences between subpanels' surfaces of ideal points.
One contrast was that those who bought for taste ranged higher in their tolerances of both thick spread and percentage of fat, whereas those who bought for fat content ranged lower in both. If this difference stood up to further investigation, it could provide a quantitative basis for differentiating between two positions in the market, as has indeed been done. Those with concerns about dietary fat can be provided with low-fat spreads. These have the convenience of not becoming hard in the cooler. Indeed they have to be stiffened, e.g. with milk protein, which creates another advantage to health.

Diversity of Cognitive Style

Panels also differed in distributions of the cognitive 'style' of decisions about acceptance of spreads (compare Gabay, Flores, Moskowitz and Maier, 2010). Relatively more of those who bought for taste than the fat-concerned who used their own terms (indirectly) described fat contents in separate processes (2D), whereas the incidences were the other way round when consensus vocabulary was used. Perhaps there were idiosyncrasies in what was liked that free-choice vocabulary captured better. Some of these could have been a subconsciously sensed characteristic of spread, since the commonest separate description of fat content (IND-2D) was with a (direct) stimulatory influence of amount of spread. Separate description of amount was also more common in this subpanel, which could be a more conscious sensory appreciation. Substantiation of different ways of coming to a decision to accept a spread that are stable and prevalent could be relevant to the market concepts used to guide formulation of brand of spread. Using the present approach, marketing strategy would be informed by objective and quantitative evidence of the sensory-conceptual interactions in individual consumers.

To summarise the above points, rather subtle aspects of such findings as these should not be neglected in product development strategy, so long as they stand up to testing in panels representative of the whole market.

Managing Laboratory and Field Research

This paper challenges two related theses in the management of consumer and marketing

research. One is that consumer sensory data should not be mixed with 'hedonic' data on acceptance or preference. The other is that surveys of market prospects cannot be related in theory or practice to human responses to materials in the laboratory. These myths were debunked in the 1980s (Booth, 1987, 1988a, 1990; McBride and Booth, 1986). Yet they persist in textbooks, professional training, research structures and product development cycles, even though new efforts have been made to unite the field (Moskowitz *et al*., 2006).

The results of the experimentally designed exhibition test show the potential of the personal cognitive approach for combining sensory and marketing factors in the same study. Response surfaces are readily constructed across sensed material characteristics and labelled conceptual attributes. The prevalence of different cognitive strategies in the popularity peaks can be estimated. The relative dominance of different factors in the appeal of a marketed product can be measured. More detailed questioning can flesh out the content of the decision processes identified. All this is possible because each response to either a material or symbolic feature of the market proposition is scaled on the universal unit of discrimination from the individual's memory standard for a particular use.

For simplicity in illustrating the basic principles, the experiment reported here focused on one sensed material characteristic and a single labelled attribute. Also the data were collected in a situation somewhat different from any common point of use or purchase. Nevertheless, the contrast with more complex studies or more realistic situations is more apparent than real. Many studies using long lists of verbal responses and also many varied material and/or conceptual features fail to reduce either dependent or independent variables to their latent variables or classes. Indeed it often appears that just one or two clusters or principal components account for much of the observed variance. If so, the richness of raw data generated by such designs is illusory. Sensory and consumer research could make a greater contribution to knowledge and practice by restricting designs to a few uncorrelated major inputs and proven key outputs such as judgments of frequency of choice. It should also be noted that discrimination scaling is not limited to quantitative factors. So long as the absence of a categorical influence such as a brand name leaves a realistic proposition, the influence of its presence can be measured in interaction with other factors in appeal.

More generally, the theory and practice of research into the marketing of consumer goods would be greatly advanced by designing the inputs and outputs for studies to test mechanistic hypotheses about interactions among salient factors from formulation and marketing. Levels of the relevant inputs should be manipulated or selected, rather than leaving them to accidental variation or confounding. The sizes of effect of input or output variables on relative acceptance in use should be calculated. Findings would then begin to be cumulative, unlike series of reports that rely merely on p values or model each set of data by use of loose parameters with values that do not replicate.

CONCLUSION

In summary, the approach exemplified in this paper brings research much closer to the realities of consumers' decision making. The key principle is to determine the input/output processing characteristics of each individual as s/he deals with personally tolerable versions of familiar product types, and grouping only those data to seek generalisations and segmentations. The focus in this instance on only two potential drivers and the deviations from a situation of use are not inherently invalid. Fat content of a spread and its thickness on a piece of bread might prove to be among the most salient factors in what the young people investigated regularly spread on their toast at breakfast. This approach measures what is actually going on in the individual's mind during the test session. How close that mental processing is to acceptance in life depends on how well the experimental situation stimulates the memory and imagination. That is a question that needs addressing by further scientific investigation, not merely by critique based on abstract presuppositions lacking in crucial evidence.

Even this simple demonstrator crystallises some potentially key empirical issues about consumers' performance in the market with existing formulations and labelling. These issues are wide open to further elucidation within assessable realistic simulations of common situations of use, with monitoring of each eater's or shopper's decision processes without prejudgment of the individual's conceptualisation of sensed characteristics and attached symbols such as a logo, numerical information or a video advertisement.

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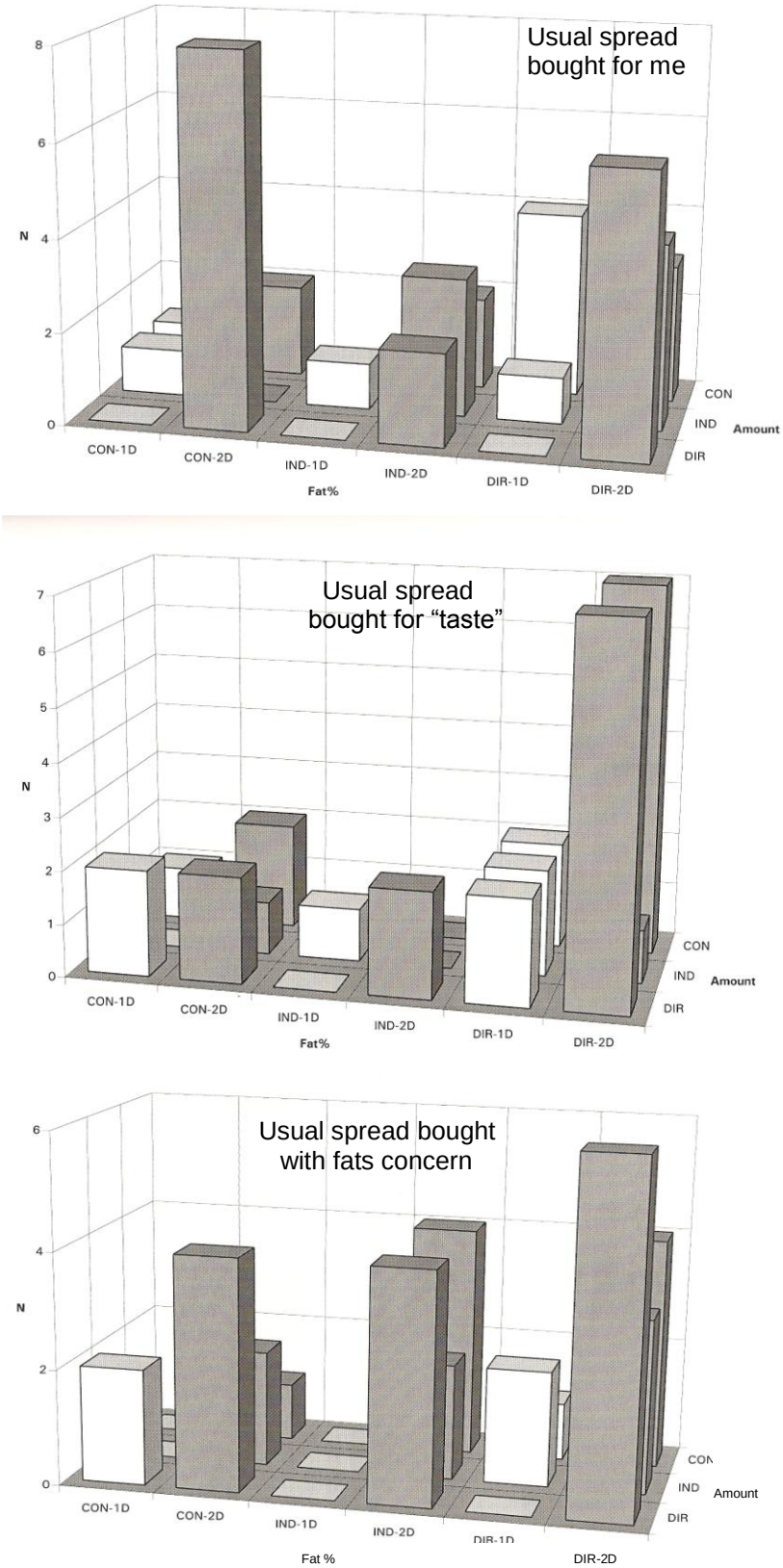
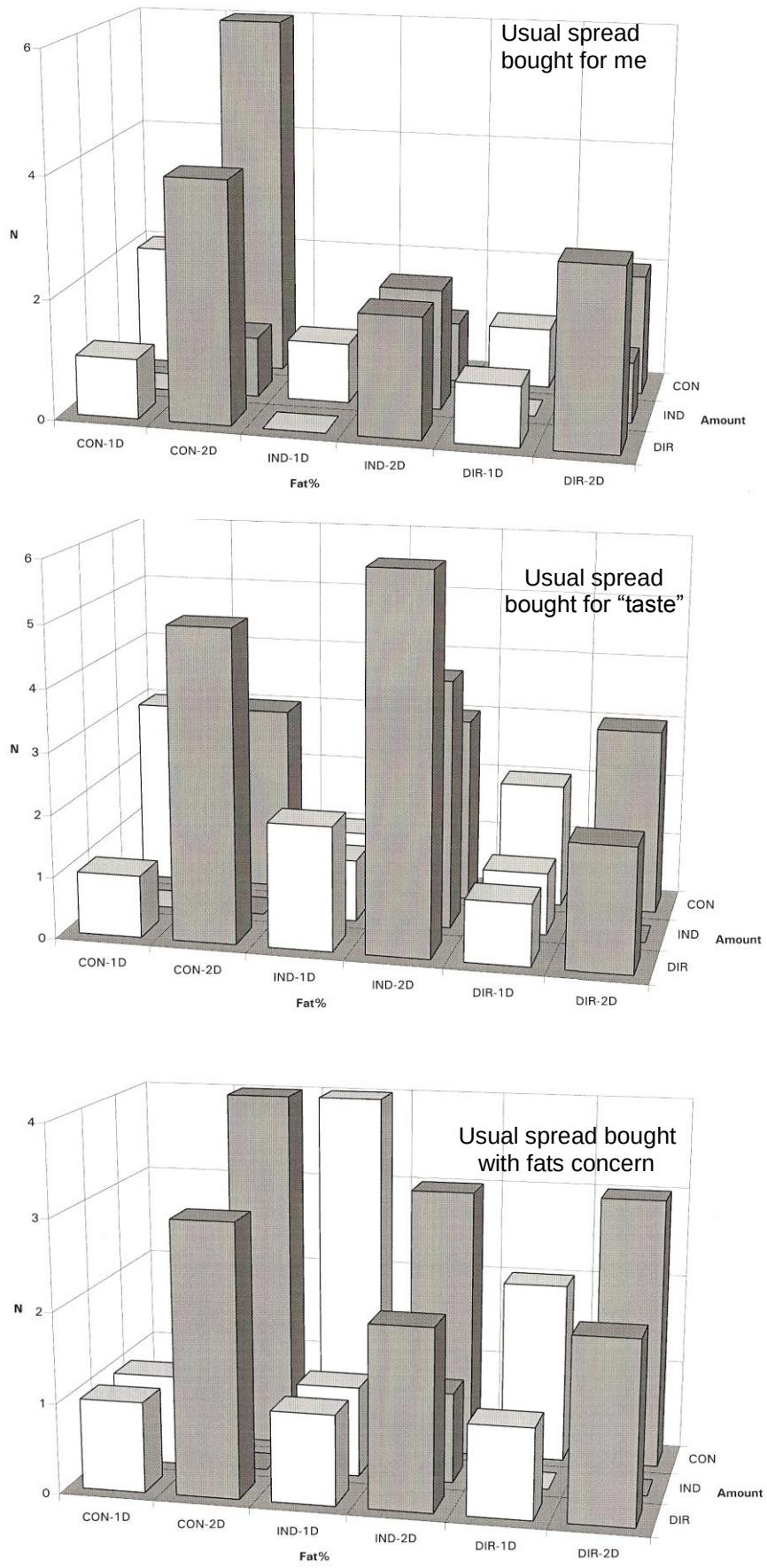
Figure 1 Sensory-conceptual interactions in consumers provided with consensus vocabulary



Notes. Column height is number of consumers using one of the 18 hypothesised cognitive strategies. Fat %: the label alongside each sample of spread on bread. Amount: the visible thickness of spread on a constant area of bread.

Top panel: consumers whose usual spread was bought for them (panel N = 37)
Middle panel: those who bought their usual spread for “taste” (N = 38)
Bottom panel: those who were concerned about fats when buying their spread (N = 35)
Types of use of conceptual or sensory information.1D (one dimension = single channel processing): treating thickness of spread and labelled % fat as a unity (total amount of fat).
2D (two dimensions = processing over different channels): treating amount and % separately.
DIR (direct stimulation): influence on preference of the sight of the amount or the % fat label; this is one type of peripheral processing.
CON (the concept's vocabulary): influence of the provided consensus wording for amount or label, also a peripheral process.
IND (indirect, central processing): influence of the descriptive relating of concept wording to sight of amount.

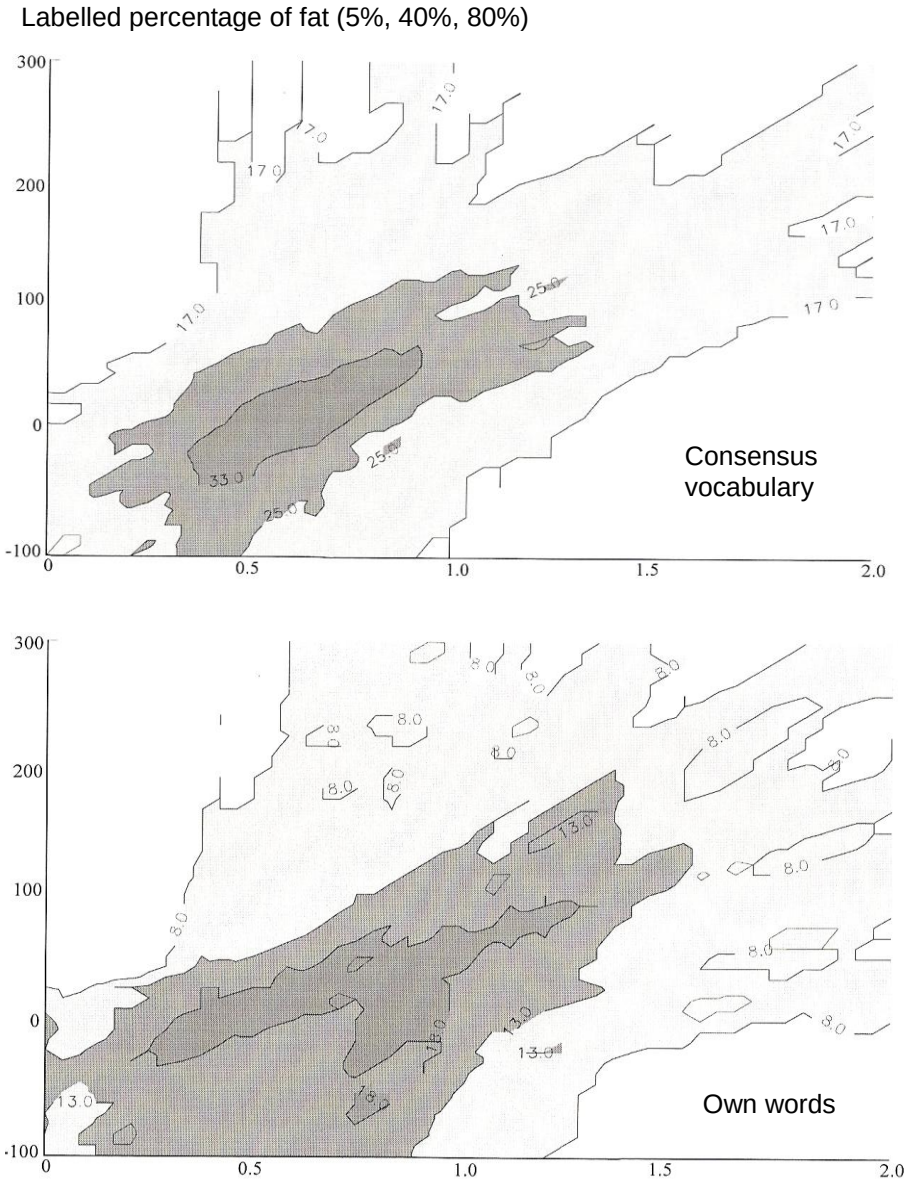
Figure 2 Sensory-conceptual interactions in consumers using their own words



Notes. Column height: number of consumers using that strategy to process the conceptual and sensory features. Fat %: labelled concept. Amount: visually sensed thickness of spread.

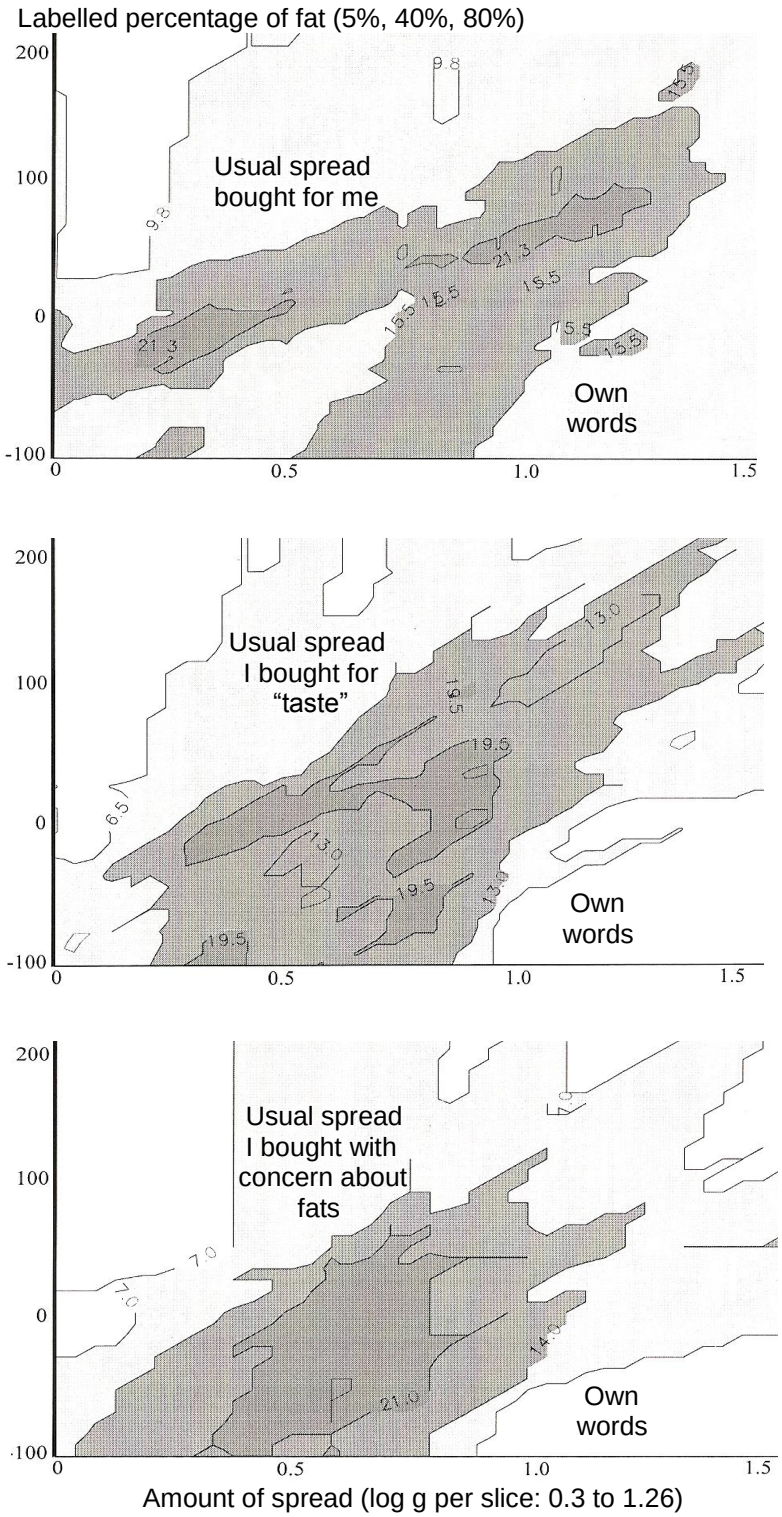
Top panel: spread bought for them (N = 28)
Middle panel: spread bought for “taste” (N = 38)
Bottom panel: spread bought from concern about fats (N = 29)
Type of sensory-conceptual integration into acceptance. 1D: treating amount of food and labelled % fat together (as amount of fat). 2D: treating amount and % separately.
DIR (direct stimulation = a peripheral process): influence on preference of the sight of the amount or the % fat label. CON (concept's vocabulary = another peripheral process): influence of the provided consensus wording for amount or label. IND (indirect, central processing): influence of descriptive relating of the label wording to the thickness sight.

Figure 3 Contour maps of percent of assessors with the amount of fat and labelled % fat within their ideal range



Notes. Upper panel: all cognitively integrative assessors using consensus vocabulary (N = 110) Lower panel: integrative assessors using their own words (N = 95)

Figure 4 Percent of integrative assessors using their own vocabulary with each person's ideal range spanning both an amount of fat and a labelled percentage as fat



Notes. Top panel: usual spread bought for them (N = 28)

Middle panel: usual spread bought for "taste" (N = 38)

Bottom panel: usual spread bought from concern about fats (N = 29)